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The agroforestry parks of Azilal (Morocco): a centuries-old and still living landscape construction

Aude Nuscia Taïbi, Mustapha El Hannani, Yahia El Khalki and Aziz Ballouche

The Moroccan High Atlas in the Beni Mellal-Khenifra region (former Tadla-Azilal region), is characterized by highly anthropized landscapes as in all the medium mountain regions of Morocco.

In this region with a semi-arid Mediterranean climate with a continental tendency (cool winter), the *Amazigh* rural population, scattered in small isolated hamlets, has built wooded parks in a context of rainfed food agriculture (*bour*), associated with extensive livestock farming, mainly sheep and goats. These are very open landscapes dominated by pre-forest formations of trees outside the forest preserved in the fields, in a context of low UAL (12% without uncultivated land, forest and rangelands). The diversity of these parks, in terms of tree density and floristic composition, is remarkable. On a regional scale, we can mention parks with holm oaks (*Quercus rotundifolia*), carob trees (*Ceratonia siliqua*) or junipers (*Juniperus phoenicea*) but in our study area the former dominate. In the phytosociological tradition of the Montpellier and Marseille schools, which have mainly studied Moroccan vegetation, these parks are seen as a secondary form resulting from the degradation of original forest formations (Achhal, 1979; Barbero *et al.*, 1981; Benabid, 1985). The phytodynamic qualifier "pre-forest formations" clearly indicates their position in vegetation series (progressive or regressive). In connection with morphogenic processes, marked locally by erosion, the anthropization processes at work have justified the use of the terms regression and degradation.

However, despite these negative representations, field and diachronic analyses at different time scales show that these tree parks have a large built component and can be read as the complex product of the relationships between societies, with their culture, their experiences, their know-how, their practices, their technologies on the

one hand, and the forms, potentialities and constraints of their environment on the other hand.

Since the landscape makes it possible to "overlap the major metaphysical categories: natural and cultural, space and social, "objective" and "subjective"" it becomes an essential medium for analyzing the "dialectic between physical laws and social "laws"" (Bertrand, 1978). It reflects the modalities of physical appropriation of the territory and its resources through their domestication and control by the farmers of this region. Because of these inseparable links, it is through the diachronic analysis of agroforestry park landscapes that we can consider understanding the dynamics of transformation, adaptation or permanence of small, landlocked mountain farmers. How do these constructed landscapes reflect the socio-cultural and economic transformations that peasant communities have undergone?

It is for this reason that we have focused here on these landscapes to better qualify them and characterize their dynamics, through dendrochronology and remote sensing, and to show the role of small farmers in these mountains in their construction and maintenance. To read these joint dynamics, we chose the rural commune of Agoudi N'Lkhir near the city of Azilal, for which there were ancient photographic resources (1919) to cover a wide temporal beam for the period of the 20th and 21st centuries.

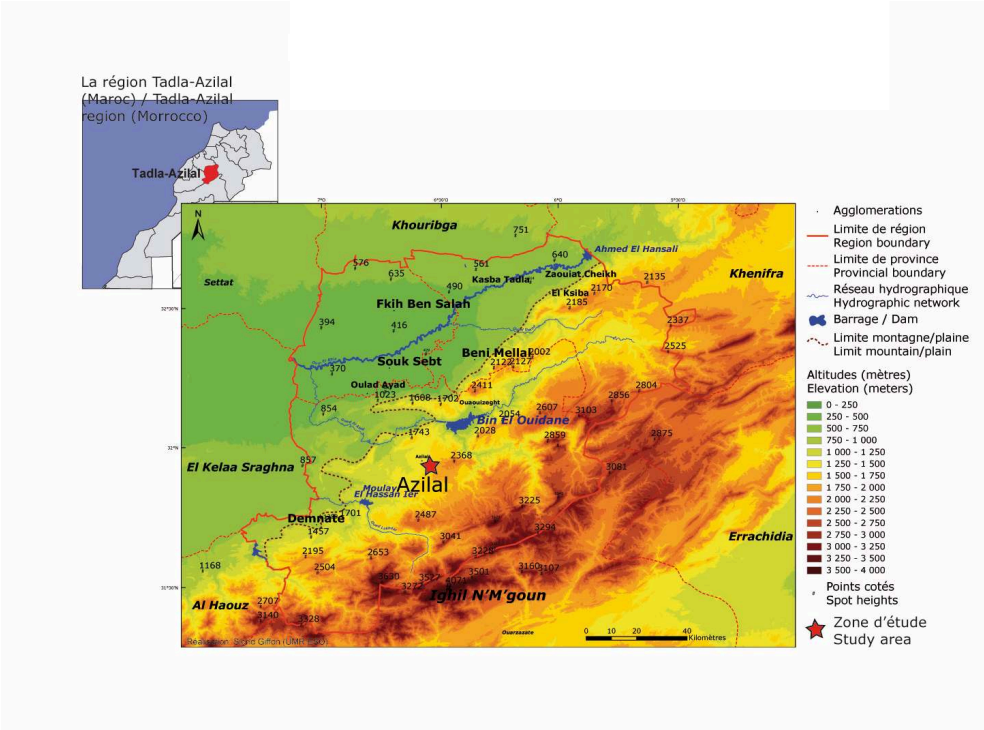
The Azilal region an under-integrated mountain region with high constraints

Mountain areas in Morocco have been under-integrated since the colonial period despite the timid catching up in recent decades (Boujrouf, 1996; Boujrouf and Giraud, 2000), and efforts since the 1980s to reduce structural handicaps have been slow to materialize (Milian 2007). The Moroccan central power (*maghzen*) has always maintained conflicting relations with an insubordinate mountain while the plains have long been dominated and subjugated. During the period of the protectorate, the mountain was described as "useless" territory by Lyautey[1] in contrast to the "useful" Morocco of the plains and plateaus (El Hannani *et al.,* 2009).

The province of Azilal (Beni Mellal-Khenifra region) in the Central High Atlas (Figure 1) is a very good example. As a region under biophysical constraint, it has also been under-integrated into national development plans since the colonial period.

Located in medium and high mountains exposed to the north and exceeding 1000 m in altitude (Figure 1), the province is characterized by a sub-humid to humid climate (average rainfall of 550 to 700 mm in Azilal and up to 1 m in the High Atlas) and cold. In winter, snow represents a significant part of precipitation (20% to 30%). This harsh climate and the strong energy of the relief of this tectonically active mountain, favours the development of poor and superficial soils with a high sensitivity to erosion.

Figure 1. Study area location and orography



These climatic, topographical and pedological constraints and the poverty of the mountain populations dedicate it above all to a dominant goat and sheep breeding, associated with a small family cattle breeding. This historically transhumant livestock farming was practiced there as part of the close complementarity between the high mountains and their foothills (*Dir*) and with the Tadla plain in the north (Figure 1). This livestock system is accompanied by an extensive cereal system in *bour [without irrigation]* or small valley bottom irrigation. Cereal farming occupied 98% of the cultivable land in the mountains in 2003, particularly barley, which covers almost all cultivated land. It is practiced on small plots, with 77% of farms having less than 5 ha and 16.3% having a size from 5 ha to less than 10 ha in 2002 in Azilal province (Taïbi *et al.*, 2014).

In these contexts, the modes of social organization in this region are structured around three major legal statuses. Private properties, known as *melk*, of which very few are registered. The forest domain with poorly delineated state status is generally appropriate by the populations for the extraction of wood and fodder, according to neighbourhood criteria for douars, criteria of old tribal finages, or by individual processes of clearing and cultivation. The third status is that of collective lands, also administratively poorly delimited, mainly dedicated to pastoralism and historically jointly managed by one or more tribal communities. However, a process of individual appropriation of collective land for cultivation or grazing (FAO, 1987) was already underway in the 1980s and, in general, traditional collective management of pastoral land has been in the process of liquidation since the second half of the 20th century.

This agriculture is still the main activity and the asset rate in agriculture in 2004 exceeded 62% in the province of Azilal. In addition, the population of this province was still rural at 81.8% in 2014 (Taïbi *et al.*, 2014).

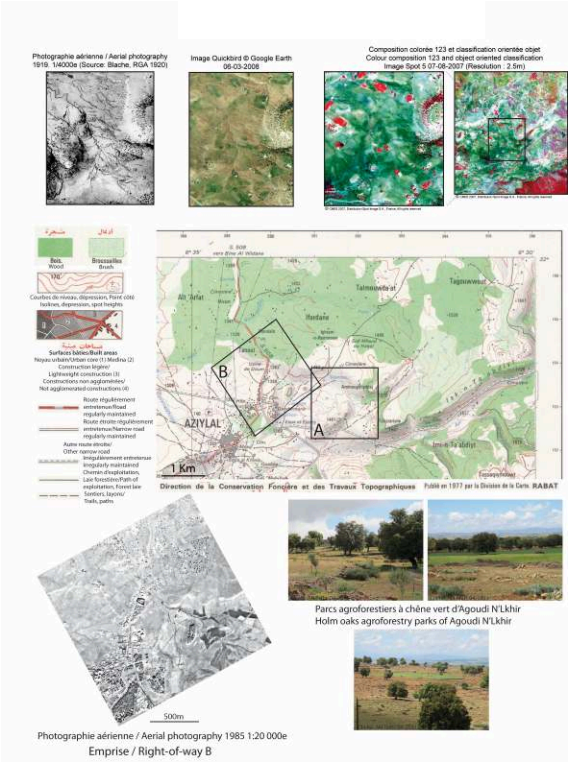
A significant part of this province lies below the upper limit of the permanent human population at an altitude of 1900-1950 m in the High Atlas (Noin, 1970) due to the winter cold that can reach -10°C. The frequent topography of the plateaus also favours human occupation. The higher and steeper spaces show only temporary installations with tents or rudimentary shelters (*azibs*) up to 2300 m (Noin, 1970) but increasingly rare with the disappearance of the transhumant system. This province is characterized by a scattered habitat resulting from a recent sedentary lifestyle in the 20th century and relatively low population densities in the mountains (45.26 inhabitants/km² in 1994 and 50.2 inhabitants/km² in 2004) offset by a strong natural increase explaining the positive population growth of this region. High fertility rates (average of 3, 4 or more children per woman) are themselves largely linked to low enrolment rates, particularly for women, and illiteracy rates above 60% (Taïbi *et al.*, 2014).

The chronic under integration of this province is also reflected in the population income figures (Taïbi *et al.* 2014). In 2009, the GDP per capita of the Tadla-Azilal region was one of the lowest in Morocco with 15,527 MAD[2] per capita against (national average > 23,000 MAD), and household final consumption expenditure of 10,109 MAD per capita, placing this region in 12th place out of 14 in Morocco (national average: 13,279 MAD). The poverty rate estimated at 9.3% in 2007 placed the region in 6th place in Morocco. In 2011, the Tadla-Azilal region also showed a marked delay in terms of health coverage, placing it among the 3 worst-off regions.

Poverty, isolation and lack of prospects explain why this is the first region of illegal emigration to Europe from Morocco (Arab 2009).

The rural commune of Agoudi N'Lkhir which interests us here is located in the circle of Azilal and the caïdat of Agoudid (Figure 2). The predominantly *Amazigh* population scattered throughout the commune, includes 11,741 inhabitants, including 1,122 farmers who combine livestock and cereal production, mainly barley (2,220 ha) and wheat (780 ha) (Bouzekraoui *et al.* 2015). At an average altitude of 1,400 m, this mid-mountain area was largely covered with wood according to the 1977 topographic map (Figure 2). However, observation from aerial photographs of 1985 and 1919 and satellite images of 2007 and 2008 shows the confusion with structures that can be described as tree parks in this commune near the city of Azilal, provincial capital. These parks appear to be either ignored or likened to woodlands on this 1977 map, but also in other scientific work or expert reports as will be discussed later.

Figure 2. Satellite images and aerial photography of right-a-way A



Tree parks as extensive production systems to adapt to these constraints

In general, this type of context under strong biophysical and human constraints explains why populations in these mountains have built extensive production systems that intentionally combine trees or shrubs with crops and/or rangelands on the same areas, making it possible to combine annual agricultural production (crop, forage) and long-term deferred production by trees (fruit, wood, coal, shade services, culture, etc.) (Sabir & Roose, 2010).

The landscapes thus produced correspond to tree-lined parks, combining the use of annual plants grown in rotation with very short-term herbaceous wastelands, in close association with the breeding of transhumant sheep and goats (Dufumier, 2004), gradually settled since the colonial period. Here, as in other Mediterranean mountains, they constitute agro-sylvo-pastoral systems that make it possible to integrate the management of all the resources of these poor rural territories, thus endowing them with multiple functions and offering economic, environmental and social services. Thus, trees and shrubs selected in the fields and voluntarily maintained to interact with crops and/or livestock, contribute to fertilizing the soil. The fall of their leaves constitutes a supply of organic matter that allows cereals to be grown on small plots in these mountainous contexts with poor soils. These foliage, and ground litter, provide surface protection and, by stimulating microfauna and microflora and improving infiltration capacity, contribute to improving the water balance, while limiting erosion on slopes that are often steep in the mountains (Sabir & Roose, 2010). Soil enrichment is also achieved through the recovery by the deep roots of trees of some of the

fertilizing elements leached from the soil or released by rock alteration. All these processes promote the quantitative and qualitative improvement of biomass production and an increase in yields for farmers. Trees also provide protein-rich green aerial fodder for animals left to graze in vain. They are regularly pruned to ensure a reserve of fodder for unfavourable periods. Repeated pruning is the very cause of the often bushy habit with twisting branches of trees. This diversification of farmers' activities and production, spread over the whole year, corresponds to particularly effective protection in mountain contexts subject to climatic crises, particularly droughts or cold spells, and relatively populated. These agroforestry parks also constitute a heritage of valuable trees that are favourable to biodiversity.

However, despite all these major functions and services, Moroccan tree parks are poorly recognized and remain qualified as degraded formations of pre-existing "climatic" forests (Achhal 1979, Barbero *et al.* 1981, Benabid 1985, Bouzekraoui *et al.* 2015). These representations of degraded environments are regularly reported in reports or even scientific work on these regions.

Thus, since 1987 for FAO, the very high livestock load of the UAL in Azilal province, with no less than 0.3 UGB/ha of *bour*[3] equivalent, which is twice the national and regional averages, has resulted in strong pressure on the forage resources extracted for this livestock on forest and non-forestry rangelands. FAO concluded that these rangelands were "in a state of clear degradation" and that there would be "annual forest decapitalization corresponding to about 1.5% of the volume of standing timber" and that "this degradation of rangelands and forests (as well as the erosion of agricultural land) compromises not only the sustainability of the agro-sylvo-pastoral resources from which the province's population derives its livelihood, but also the province's role as a water tower for the lowland areas" (FAO 1987). As G. Fay (1986) said, "Whoever travels through the region on foot or on mules hardly crosses anything more than effervescent formations with severely delimbed trees: degraded forests could be said to mean that, at the same time, their biomass is decreasing and their extent is shrinking."

In contrast to these conclusions, it can be argued that the extensive but integrated nature of these production systems, both in the short and long term, makes it possible to support these high pastoral burdens. Indeed, the paradox is that these wooded parks constitute on the contrary a resource of pasture and quality wood, relieving the pressure on the surrounding forests, especially firewood and service wood. In addition, these systems improve the value of natural resources, because the sum of wood production and agricultural production of an agroforestry plot is greater than the separate production obtained by a forest agriculture rotation on the same area (Sabir and Roose, 2010).

We can also mention the stages of degradation considered to be the most advanced, namely the vast plots where the doum palm (*Chamærops humilis* dwarf palm) grows as a mosaic in the wooded parks. These degraded scrubs (according to the phytodynamic name) would indicate a severe degradation of vegetation and soil depletion. Under a different perspective, these formations are far from being totally negatively connoted and are, or have been, integrated into production systems (fibres, ropes, mats, etc.). In the Azilal region, doum slicks were the subject of significant industrial activity during the colonial period, which has now disappeared. This is evidenced by the "Doum factory" shown on the 1977 topographic map (Figure 2). Used to produce vegetable

horsehair, the doum had to be harvested near the plant because the cut leaves had to be processed fresh within 24 or 48 hours of collection.

These agroforestry systems therefore take advantage of the complementarity of trees (high perennial biomass and deep rooting) and crops (limited to a few months and superficial rooting) to better develop the resources of the environment. These practices can therefore be described as environmentally friendly and also offer an obvious landscape interest that has been recognized elsewhere for their heritage character, such as the *Dehesas* and *Montados* of the Iberian Peninsula (Vicente & Alès, 2006; Centeri *et al.,* 2016).

Paradoxically, it is the FAO that gives a definition of "non-forest" trees that do not belong to either the "forest" or "other wooded land" category. They are part of the "other land" category, which includes agricultural areas (including meadows and pastures), built areas and barren land. Trees are defined as "out of forest" if they cover areas of less than 0.5 ha in one piece and reach a height of at least 5 m at *in situ* maturity and a cover of less than 5 %, or a height of less than 5 m at *in situ* maturity and a cover of less than 20 %. Out-of-forest trees are therefore considered to be trees spread in grazing areas, permanent tree crops (such as fruit trees), located along roads, rivers, streams and canals and in curtains (Bellefontaines *et al.* 2001).

In our study region, when they are not qualified as degradation formations, tree parks are totally invisible to developers and scientists. Thus, the various development reports on the region consulted never mention this type of land use and only consider forest formations, with high stands or matorrals of hardwood (holm oaks) or softwood (Aleppo pine, cedar and junipers). Only "scattered subjects" or a "pastoral forest cultivated in bour *[without irrigation]* on the Azilal plateau" are mentioned, very briefly, but not studied (FAO 1987).

In the commune of Agoudi N'Lkhir, the tree parks are physically in the form of stands of low-density trees outside the forest (10 to 50/ha) built by the former association of extensive and domestic livestock farming and rainfed barley cultivation (*bour*). The trees, mainly holm oaks (*Quercus rotundifolia*), but also carob trees (*Ceratonia siliqua*), structure tree parks maintained by agroforestry treatment with regular grape-growing practices, but also by grazing, systematic pruning of holm oaks for winter fodder, collection of acorns or carob trees and wood and coal production.

Pruning of holm oaks (old and young) and grazing by sheep and goats on plots of grass or barley (Agoudi-N'Lkhir commune)

Taïbi's photographs, 04-2011.

However, tree parks are not represented on the 1977 1:50,000th topographic maps, which equate them with woodlands or completely ignore them (they are then white as cultivated or uncultivated areas) (Figure 2). Some scientific work that has focused on agroforestry parks in this area (Bouzekraoui *et al.,* 2015), includes 13,181 trees in Agoudi N'Lkhir commune and seeks to identify their place in farmers' representations and practices. They conclude that the region's forests have declined drastically since the

1970s (from 876.44 ha in 1977 on the topographic map to 1:50,000 to 190.1 ha in 2008 according to GeoEye images, a decline of more than 36%) and paradoxically do not mention the dynamics of the parks themselves. This reflects the recurrent confusion between the different objects of forests, woods, tree parks and agroforestry parks already noted on the 1977 maps.

The study at different temporal scales of the tree parks of this rural commune makes it possible to moderate, even refute, these descriptions and to highlight the complexity of these landscapes produced by the long-term confrontation between the communities and their environment.

The wooded parks of the Azilal region, a centuries-old peasant landscape construction that is still perennial

The landscape construction revealed by the structure and physiognomy of tree parks and their evolutionary dynamics is old. This is shown by their historical approach, through dendrochronological analyses and diachronic monitoring of satellite images and aerial photographs on the commune of Agoudi N'Lkhir.

The dendrochronological study was carried out on a dozen holm oaks in this commune near the city of Azilal. The Pressler auger boreholes were carried out on old trees with a trunk diameter of between 60 and 100 cm. They revealed that most of these individuals had a hollow medullar canal, which does not allow for the entire life of the tree to be covered by coring, as the thickness of the trunk wall is often less than 20 cm. Analysable dendrological sampling was performed on two individuals who delivered 313 mm and 192 mm cores. On these cores were counted 122 and 77 growth rings respectively. For the first, the average thickness of an annual ring is 2.57 mm, while it is 2.49 mm for the second. This allows us to estimate the average annual growth of holm oaks at this site at 2.54 mm per year over the last century. Even if this growth may have been more or less strong in the past, it can be considered on the basis of the diameter of the two trees in question that their respective ages would be 160 years and 177 years. On this basis, it is possible to consider that most of the holm oaks structuring the park in this area are about 200 years old, with the oldest being up to 300 years old, perhaps more.

On the physiognomic level, the majority of trees have a multi-cornered habit, generally with three or four trunks resulting from stump rejections. This morphology indicates a regular treatment by long rotation coppicing, here of secular scale. Some of the starting strains of the rejet have diameters of more than 120 cm, so they themselves are more than 230 years old at the time of their cutting, more than 200 years ago. This makes it possible to trace the structure of the tree park back at least 500 years. The almost systematic presence of hollows in the medullar canal of these oaks is an interesting indication of their age. In a certainly different climatic context (in Sweden), the study by Ranius *et al.* (2009) estimated the age at which hollows begin to form for the pedunculated oak (*Quercus robur*). Between 200 and 300 years old, 50% of the trees had hollows, while among trees under 100 years old, less than 1% had hollows. Finally, trees over 400 years old all had hollows.

The rounded silhouette of the large trees, with large branches spread out, confirms that these individuals must have grown for hundreds of years in open areas and have

never belonged to a closed forest stand. This character of trees outside the forest, in a maintained space, is also confirmed by the absence of any trace of fire in the dendrological cores for at least 200 years. Indeed, in the absence of grassy, bushy, shrubby or continuous tree biomass, fire cannot circulate through a plant formation.

In the absence of paleoenvironmental data on our site, these data should be placed within the regional framework provided by the closest previous work in the High and Middle Atlas. In these regions, all pollen diagrams show a regular regression of the holm oak, always linked to anthropisation, in particular grazing, the impact of which is sometimes identified as early as the first millennium BC, but this decline increases about 1000 years ago, then around the 16th and 17th centuries (Reille, 1976; Lamb *et al.,* 1991; Ballouche, 2001; Cheddadi *et al.,* 2015). The difficulty in interpreting these pollen data, which objectively reflect a decline in holm oak forests, is to distinguish the traditional degradation processes (matorralisation) from evolutions towards agroforestry-oriented tree parks (Ballouche, 2013).

The study of the wooded park on shorter time scales of the 20th and 21st centuries also shows the permanence of the landscapes and their very open structure.

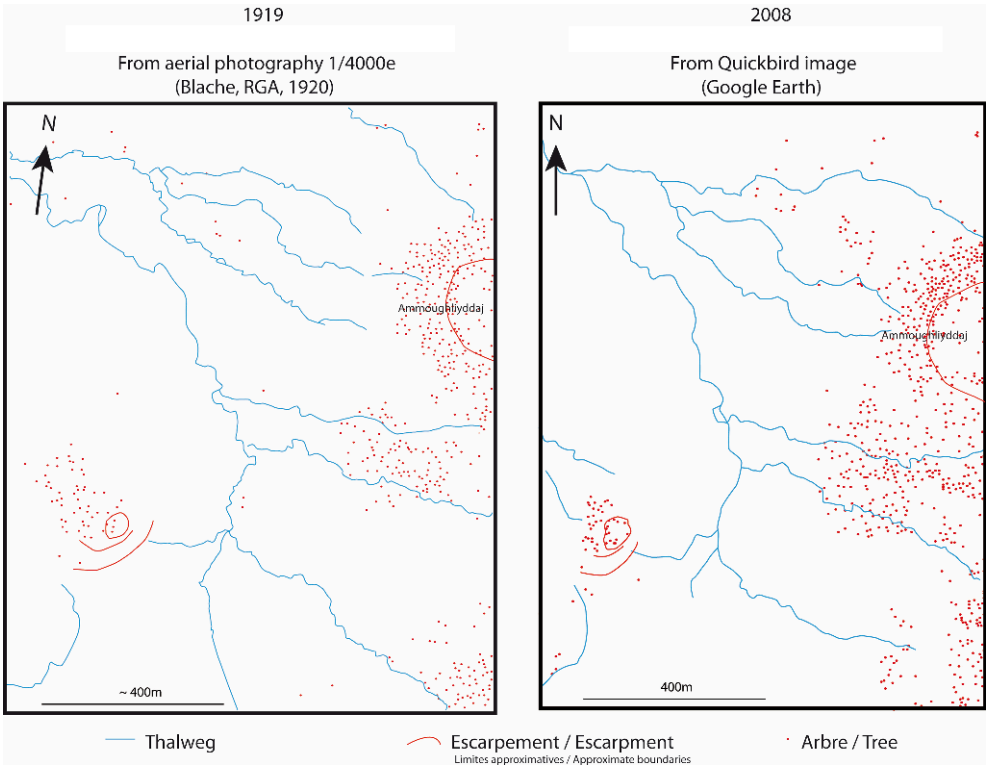
Diachronic monitoring of the municipality of Agoudi N'Lkhir based on aerial photographs (1985 to 1/20,000th and 1919 to 1/4,000th) and satellite images (Spot 5 07-2007 and Quickbird 03-2008 from Google Earth) indicate that these landscapes and related practices are still alive in the terroirs around the city of Azilal. These landscapes of trees outside the forest have been characterized and their dynamics monitored since the beginning of the 20th century thanks to an oblique aerial photograph from 1919 by the Moroccan Aviation Photographic Service illustrating an article by J. Blache from 1920. The footprint of this 2.25 km² photo was used to study satellite images (Figure 2). The 1985 photo does not cover the same area, but also shows tree-lined parks north of Azilal in the commune of Agoudi N'Lkhir (Figure 2). Aerial photos cannot be superimposed on georeferenced satellite images, because our objective was not to study the precise dynamics of each individual but to identify and count ligneous trees on different dates and to establish a diachronic follow-up since 1919. The results were used to visually characterize the park landscapes, locate them and highlight their overall dynamics in this otherwise small area.

We implemented on all the images and the 1919 photo an object-oriented segmentation and classification approach with the Envi Ex software, focused on the tree component of the parks. The advantage of this method is to use the spectral characteristics of the images but also geometric (length, perimeter...), topological (position in the image and in relation to other objects) and semantic (related to its meaning) to identify objects (Boggs 2010). However, these elements of form, texture, context and relationships between objects are those that allow the human operator to easily define landscape units visually from aerial photos or in the field. The subdivision of images into objects by the object-oriented method is similar to the way humans think and conceptually organize landscapes to understand them. Each tree individualized by the spectral, textural and spatial attributes of its crown can then be exported to a GIS in separate polygons.

Diachronic monitoring, both by dendrochronology and photo-interpretation with field validation in 2011 and 2012, clearly shows the existence of the tree parks in the Azilal region for at least 4 or 5 centuries and the permanence of their overall structure since 1919. These parks occupy the plateaus quite loosely and tend to become denser on the

cultivated slopes. However, only a few trees are found in the bottom of the swampy valley in the central part of the study area. In the terroirs located to the east of the city of Azilal, four main areas are identified on each date (Figure 3). With 537 isolated trees in 2008 compared to 425 in 1919, these stands, far from showing a decline, have on the contrary developed. Only the area closest to the city of Azilal, to the west of the images, shows a decline in the number of trees, from 56 in 1919 to 49 individuals in 2008. On the slopes of the Ammoughliyddaj plateau, the trees became denser (175 in 1919 and 192 in 2008) and overflowed into the marshy plain and south of the area (1919: 151 trees, 2008: 252 trees). On the plateau itself, the number of trees remained stable with 43 in 1919 and 44 in 2008. In the field, if the observation of older trees has been favoured for dendrochronology, it is significant that younger individuals are generally single-stemmed (single stem), which would indicate the absence of treatment by coppicing. While the permanence of the very open structure of the stands may indicate a relative sustainability of their maintenance by farmers and therefore of the functions and services provided by these tree parks, it also seems that these systems are undergoing changes linked both to a relative decline in agriculture and to the impact of forest measures repressive of past practices. However, a precise understanding of these dynamics requires even more detailed analyses of the practices of the farmers in these terroirs.

Figure 3. Tree-covered settlement east of the town of Azizal in 1919 and 2008



Conclusion

In the Middle and High Atlas, rural areas have been subject to profound changes since the colonial period due to the dissociation of border areas (*dirs* and foothills) from mountain areas and the loss of homogeneity of the production system prior to

colonization (Jennan, 1989). However, the Azilal region shows a relative permanence of agrarian practices that is reflected in the landscape of tree-lined parks. In reality, these transformations, "far from tending towards a homogenization of the countryside, lead on the contrary to an increasing regional diversification within the Middle [and High] Atlas... spaces visibly in mutation adjoin spaces where everything seems fixed" (Jennan, 1996).

However, if we observe here a durability of the landscapes of wooded parks, the region is also marked by a dynamic of transformation. The land shows a renewed interest in these terroirs on the outskirts of the city of Azilal. Stone-removal works, maintenance and repair of the stone walls delimiting the cultivated plots and controlling soil erosion, observed in situ in recent years, seem to indicate renewed investments, the results of which are still to be studied.

The tree stand, by its composition and role, is generally the indicator of the strategy that each society pursues with regard to the environment in which it is inserted (Pélissier, 1980). The dynamics of parks therefore reflects not only constantly evolving needs and techniques, but also changes in the way societies represent nature. These agroforestry landscapes are the manifestation of the relationship between farmers and their land. By its composition and the role assigned to it, the tree population is therefore far from being the result of a simple degradation but rather reveals a voluntary strategy that Atlas agro-pastoral societies are pursuing towards their environment with its potentialities and constraints. The deep historical roots revealed by the age of the trees and the centuries-old structure of the tree stands give these parks an evolving heritage character that is directly linked to the farmers' lifestyles, culture and history. Their sustainability can be read as a characteristic of the resilience of these activities in an unfavourable institutional context in mountain areas. Far from being relics of past landscapes, they are still alive and maintained by rural populations, as they continue to offer multiple vital functions and retain an important social role in these harsh and isolated mountainous contexts of the Moroccan High Atlas.

BIBLIOGRAPHY

Arab C., 2009.– *Les Aït Ayad - La circulation migratoire des Marocains entre la France, l'Espagne et l'Italie*, Presses Universitaires de Rennes.

Achhal A., 1979.– « Le chêne vert dans le Haut Atlas central: étude phytoécologique. Problèmes posés par les aménagements de la chênaie ». Thèse doct. 3e cycle, Univ. Aix-Marseille.

Ballouche A., 2001.– « Les paysages végétaux holocènes du Maghreb. Entre nature et culture. » *Actes des premières journées nationales d'archéologie,* Rabat, vol. I, pp. 120-130.

Ballouche A., 2013.– « Contribution à l'histoire récente de la végétation du Bas-Loukkos (Province de Larache, Maroc) ». *Physio-Géo*, vol. 7, pp. 67–82.

Barbero M., Quézel P., Rivas-Martinez S., 1981.– « Contribution à l'étude des groupements forestiers et préforestiers du Maroc ». *Phytocoenologia*, vol. 9(3), pp. 311-412.

Bellefontaine R., Petit P., Pain-Orcet M., Deleporte P., Bertault J-G., 2001.– « Les arbres hors forêt Vers une meilleure prise en compte « , in *Cahiers FAO conservation*, n°35, FAO, http://www.fao.org/docrep/005/Y2328F/y2328f00.htm - toc

Benabid A., 1985.– « Les écosystèmes forestiers, pré-forestiers et pré-steppiques du Maroc: diversité, répartition biogéographique et problèmes posés par leur aménagement ». *Forêt méditerranéenne*, t. VII(1), pp. 53-64,

Bertrand G., 1978.– « Le paysage entre la Nature et la Société », in *Revue géographique des Pyrénées et du Sud-Ouest*, t. 49, fascicule 2, Géosystème et aménagement. pp. 239-258

Blache J., 1920.– **«** Quelques aspects des montagnes marocaines »**,** in *Revue de Géographie Alpine*, Vol. 8, n°2, pp. 225-258.

Boggs GS., 2010.– "Assessment of Spot5 and Quickbird remotely sensed imagery for mapping tree cover in savannas", in *Intern. journal of applied earth observation and geoinformation*, n°12, pp. 217-224.

Boujrouf S., 1996.– « La montagne dans la politique d'aménagement du territoire au Maroc : principes de zonage et d'aménagement », in *Revue de Géographie Alpine*, n°4, p. 95-108.

Boujrouf S., Giraud F., 2000.– « Les territoires qui s'ignorent ? Dichotomie entre territoires administratifs et espaces de mobilisation au Maroc », in *Montagnes Méditerranéennes*, n°12, pp. 61-69.

Centeri C., Renes H., Roth M., Kruse A., Eiter S., Kapfer J., Santoro A., Agnoletti M., Emanueli F., Sigura M., Slámová M., Dobrovodská M., Štefunková D., Kučera Z., Slámová, M., Varga A., Villacreces S., Dreer J., 2016.– "Wooded grasslands as part of the European agricultural heritage", in Agnoletti M. & Emanueli F. (eds), *Biocultural Diversity in Europe*, Springer, pp. 75-103.

Cheddadi R., Nourelbait M., Bouaissa O., Tabel J., Rhoujjati A., López-Sáez J.A., Alba-Sánchez F., Khater C., Ballouche A., Dezileau L., Lamb H., 2015.– "History of human impact on Moroccan mountain landscapes". *African archaeological Review*, vol. 32(2), pp. 233-248.

Direction de la statistique, 2009. – *Les indicateurs sociaux du Maroc en 2009*, 249 p.

Dufumier, 2004. – *Agricultures et paysannerie des Tiers mondes*, Khartala.

El Hannani M., Taïbi A.N., El Khalki Y., Benyoucef A., 2009. – « Le paysage à l'épreuve des "nouveaux" défis de l'aménagement du territoire au Maroc : contraintes et perspectives. Le cas de l'Atlas des paysages du Tadla-Azilal », in *Projets de paysage* http://www.projetsdepaysage.fr/fr/le_paysage_a_l_epreuve_des_nouveaux_defis_de_l_amenagement_du_territoire_au_maroc_contraintes_et_perspectives

FAO, 1992.– *Gestion durable des ressources naturelles. Kit pédagogique - Volume II: Manuel de base*, Division d'Analyse des Politiques Division des Forêts, CIHEAM Institut Agronomique Méditerranéen de Montpellier.

FAO/PNUD, 1987.– « Développement et aménagement des zones de montagne du Haut Atlas central, volume II », Rapport au gouvernement marocain, annexes 1 à 4, Organisation des Nations Unies pour l'alimentation et l'Agriculture.

FAO/PNUD, 1988. – « Développement et aménagement des zones de montagne du Haut Atlas central, volume I », Rapport au gouvernement marocain, Organisation des Nations Unies pour l'alimentation et l'Agriculture.

Fay G., 1986.– « Désagrégation des collectivités et dégradation des milieux dans le Haut Atlas marocain ». In: *Revue de l'Occident musulman et de la Méditerranée,* n°41-42, pp. 234-248.

Gruner R., 1984.– *Du Maroc traditionnel au Maroc moderne: le contrôle civil au Maroc, 1912-1956*, Nouvelles éditions latines, Paris, 257 p.

Jennan L., 1996.– « L'évolution des structures socio-spatiales du Moyen-Atlas central : 1e cas du pays Amekla (Sefrou) », in *Revue de géographie alpine*, Vol. 84, n° 4, pp. 61 - 74

Lamb H.F., Damblon F., Maxted R.W., 1991.– "Human impact on the vegetation of the Middle Atlas, Morocco, during the last 5000 years". *Journal of Biogeography*, vol. 18, pp. 519–532.

Milian J., 2007.– « Le dilemme entre développement et protection dans les montagnes du Maroc – le cas des parcs du Moyen Atlas », in *Géocarrefour*, vol. 82, n°4, pp. 177-186.

Ministère de l'agriculture et de la réforme agraire, 1977.– Carte topographique feuille Azyilal, feuille NH-29-XXIV-3d

Pelissier P., 1980.– « L'arbre dans les paysages agraires de l'Afrique tropicale », in *Cah. ORSTOM, sér. Sci. Hum*., vol. XVII, n° 3-4, pp. 131-136.

Ranius T., Niklasson M., Berg N., 2009.– "Development of tree hollows in pedunculate oak (*Quercus robur*)". *For. Ecol. Manage.*, vol. 257, pp. 303–310.

Reille M., 1976.– « Analyse pollinique de sédiments postglaciaires dans le Moyen Atlas et le Haut Atlas Marocains: premiers résultats ». *Ecologia Mediterranea*, t. 2, pp. 153-170.

Sabir M., Roose E. 2010.– « Zones forestières : l'arbre et la GCES », in Roose E., Sabir M., Laouina A. (eds), *Gestion durable des eaux et des sols au Maroc*, IRD Éditions.

Taïbi A.N., El Khalki Y., El Hannani M. (eds) 2015.– *Atlas régional Région du Tadla Azilal (Maroc)*, Université d'Angers, http://okina.univ-angers.fr/publications/ua9275.

Vicente Á.M., Alés R.F., 2006.– "Long term persistence of dehesas. Evidences from history". *Agroforestry Systems*, vol. 67(1), pp. 19-28.

ABSTRACTS

The Moroccan Central High Atlas in the Beni Mellal - Khenifra region (Azilal Province) is characterized by highly anthropized landscapes as in all the medium mountain regions of Morocco. These are tree parks built by the rural *Amazigh* population in a context of rainfed food agriculture (*bour*), associated with extensive livestock farming, mainly sheep and goats. The very open landscapes are dominated by pre-forest formations of trees outside the forest (dominant holm oaks) selected in the fields. Dendrochronological analyses on holm oaks in the municipality of Agoudi N'Lkhir show that a large number of them are 200 to 300 years old and their regular treatment by long rotation (secular) grape varieties raises the structure of the tree park to at least 500 to 600 years. Despite this ancient historical foundation, these highly anthropized formations are often approached in terms of degradation, as are morphogenic processes, which are locally marked by strong erosion. However, field observations and diachronic analyses based on satellite images and aerial photographs show that these tree-lined parks, far from being relics of past landscapes, are still perennial and maintained by rural populations, as they continue to offer multiple vital functions and retain an important social role in these harsh and isolated mountainous contexts of the Moroccan Central High Atlas.

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Keywords: agroforestery, degradation, « anthropized » landscape, Central High Atlas, Azilal, Morocco.

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